

# Lesson 4

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Representing and Explaining Relationships

# How could you represent some of the statistics below?

## How do we make patterns in numbers visible?

**U.S. and Global Temperature.** Average temperatures have risen across the contiguous 48 states since 1901, with an increased rate of warming over the past 30 years. Seven of the top 10 warmest years on record have occurred since 1998. Average global temperatures show a similar trend, and the top 10 warmest years on record worldwide have all occurred since 1998.

**U.S. and Global Precipitation.** Total annual precipitation has increased in the United States and over land areas worldwide. Since 1901, precipitation has increased at an average rate of 0.15 inches per decade in the contiguous 48 states and 0.09 inches per decade over land areas worldwide.

**Heavy Precipitation.** In recent years, a higher percentage of precipitation in the United States has come in the form of intense single-day events. Nationwide, eight of the top 10 years for extreme one-day precipitation events have occurred since 1990. The occurrence of abnormally high annual precipitation totals (as defined by the National Oceanic and Atmospheric Administration) has also increased.

# Representing Scientific Data

The kinds of models that scientists and science educators use vary widely, and can include:

- physical models (think about a 3-D map of a landform)

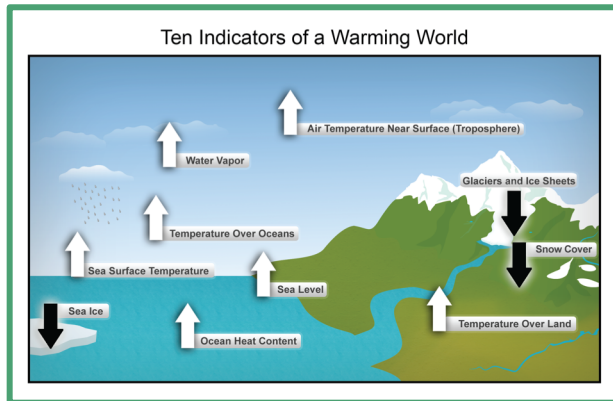
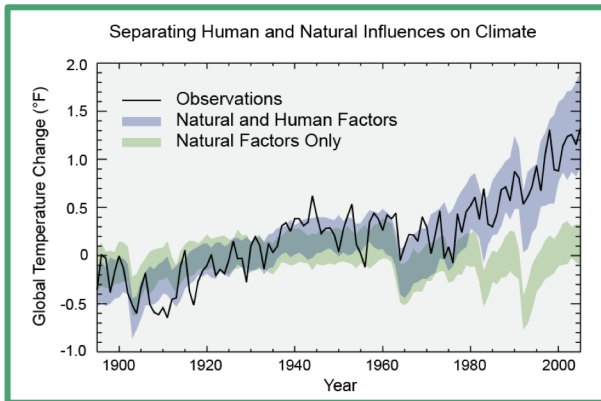
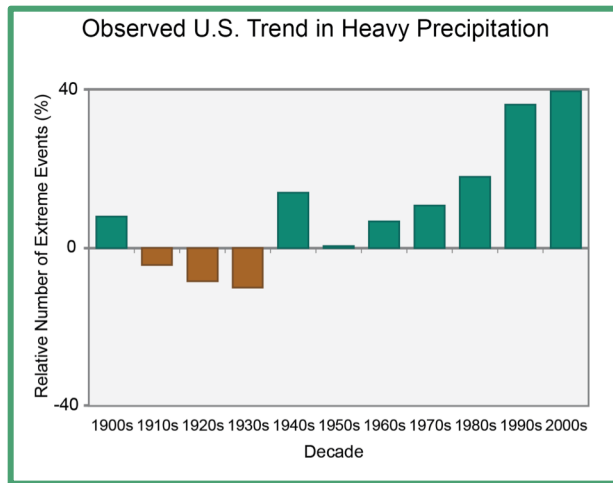
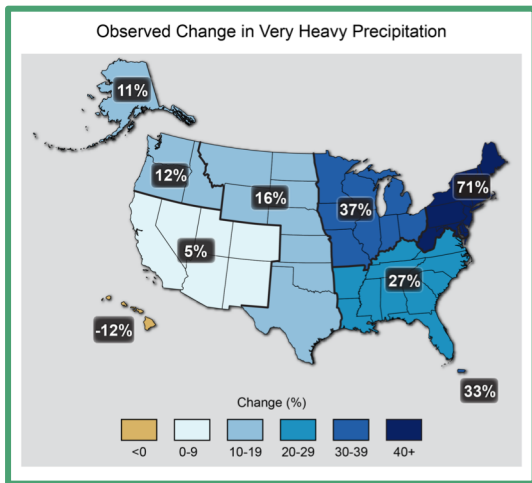
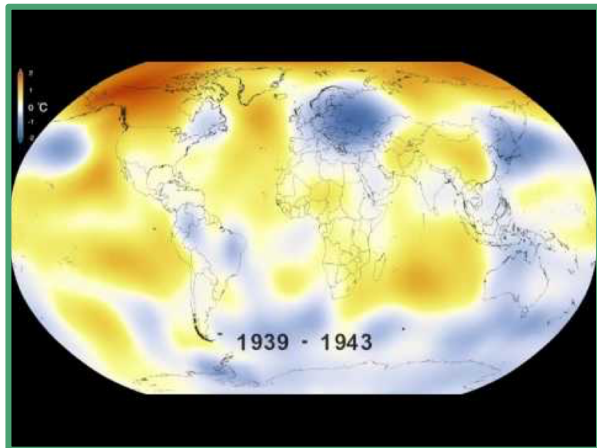
- statistical models

- diagrams

- and other graphs or graphic representations

# Some Examples: Representations of scientific data related to climate change

Graphic: Global Warming from 1880 to 2015



# Analyzing and interpreting your data to develop and explanation

## Claim-Evidence-Reasoning (CER)

Claim	Evidence	Reasoning
<p>A claim is a statement or a conclusion that answers your research question.</p> <p>A claim describes the relationship between the variables (dependent and independent) you investigated.</p>	<p>Evidence is the scientific data you use to support your claim.</p> <p>Evidence must be:</p> <ul style="list-style-type: none"><li>• <b>sufficient</b> - <i>you need enough evidence to support your claim</i></li><li>• <b>appropriate</b> - <i>you must make sure the data you use is relevant to your claim</i></li></ul>	<p>Reasoning connects your evidence to your claim. Your reasoning shows why or how your data counts as evidence to support the claim.</p> <p>Reasoning provides justification for why your evidence is important to your claim.</p>

# Template for Poster Presentation

Research Question:

Claim:

Data/Evidence:

Explanation/Reasoning:

# How certain are you? What is the relationship?

In science, you describe what the data show. You then use different terms to describe how certain you are about the nature of the relationship.

In science, it is ok if you don't know everything and can't be sure about a relationship... just say so! You can even say, "We need to study this more."

Examples... how are these different?

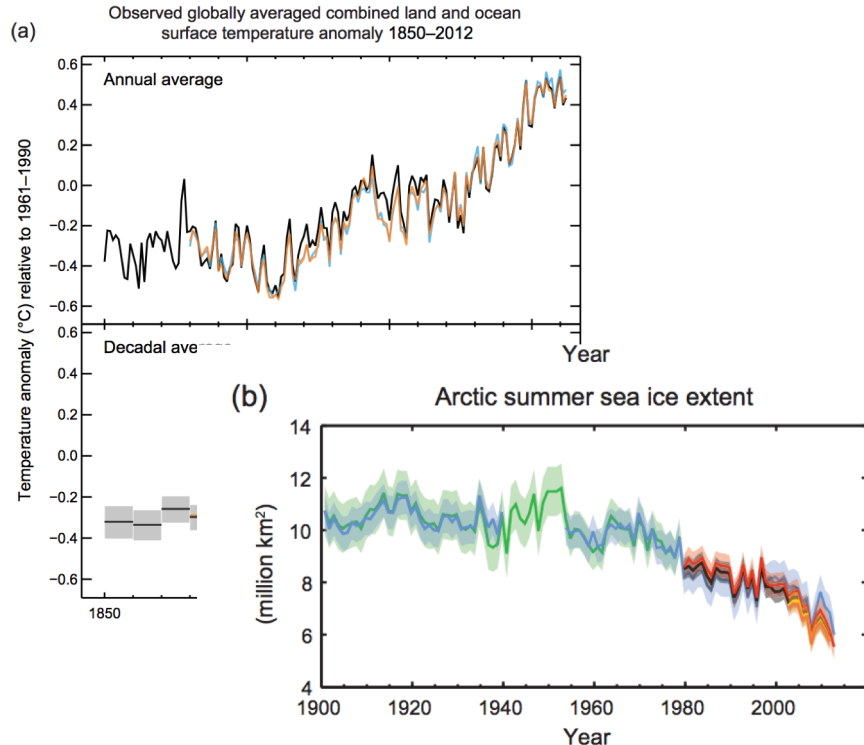
Variable A tends to increase when Variable B increases, and it appears that these increases are related because *(then you explain why....)*.

Increases in Variable A directly cause Variable B to increase. *(You better be able to prove this!)*

Increases in Variable A appear at roughly the same intervals and time as increases in Variable B. It is not clear why this might be, so further investigation is needed.

## Research Question: What is the relationship between climate change and the amount of arctic ice?

Claim: Arctic ice in the summer months has decreased as global average annual temperatures have increased. Increasing global temperatures appear to be causing arctic ice to melt more than it has in the past.



### Reasoning:

Data on average land and ocean surface temperatures from 1850-2012 show a steady increase in temperatures. Data on the extent of sea ice in the Arctic during summer months from 1900 to 2010 show a clear decline in the amount of ice.

It makes sense to conclude that rising temperatures are causing the ice to melt given that ice melts at higher temperatures. More study might be needed to figure out if there are other factors involved, but the relationship seems clear.